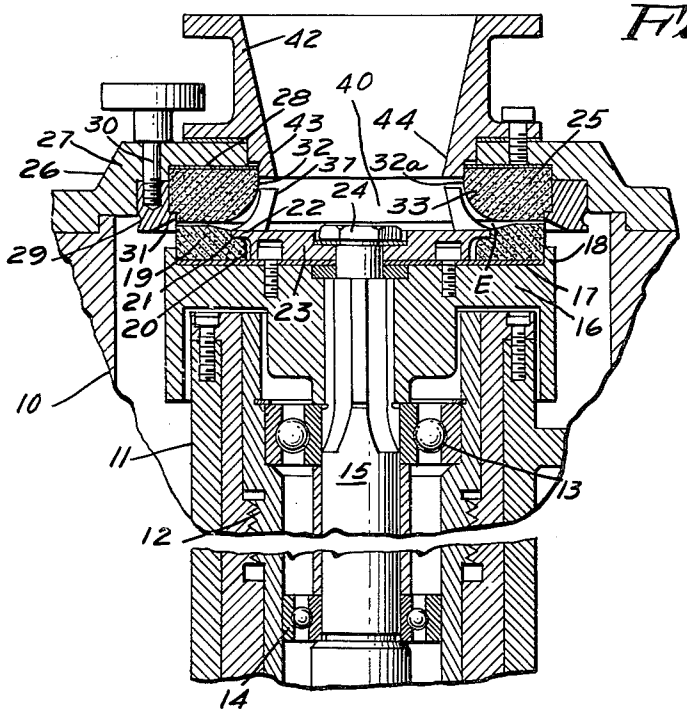
April 18, 1961 D. J. BROWN 2,980,353

HIGH PRODUCTION GRINDING MILL

Filed June 25, 1958

Fig. 1.



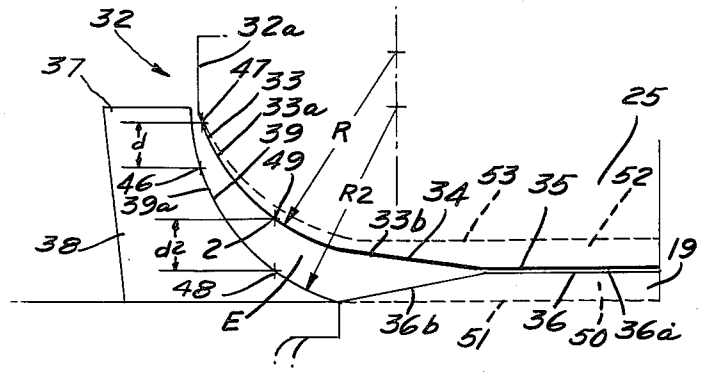
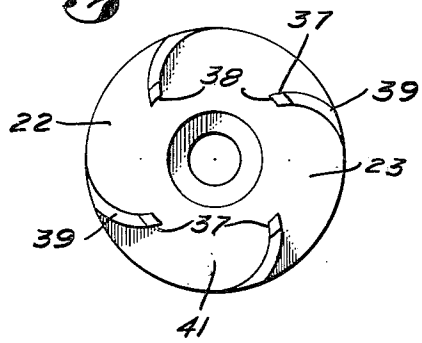


Fig. 3.

Fig. 2.



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HIGH PRODUCTION GRINDING MILL

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Filed June 25, 1958, Ser. No. 744,492

8 Claims. (Cl. 241—259)

The present application constitutes a continuation-in-part of my copending application, Serial No. 651,291, filed April 8, 1957, now abandoned.

This invention relates to grinding mills wherein materials are ground between a revolving stone and a stationary stone, and relates in particular to a grinding mill characterized by high production and positive feeding of the materials to be ground into the grinding space between the grinding members. A problem confronting the users of grinding mills of this general type is the difficulty of effectively feeding some materials into the grinding space, and to accomplish this, the use of pressure feeding devices has been adopted. For example, in the grinding of peanuts to make peanut butter a feed screw is used to force the peanuts with considerable pressure into the grinder so as to attain a reasonably good rate of production from the milling device. Also, there are materials of such consistency or composition that they tend to stick in the throat portions of the mills, or such materials may have seeds which accumulate in the internal chamber of the mill leading to the grinding space.

It is an object of the invention to provide a grinding mill having simple and effective means for positively feeding the materials to be ground into the grinding space between the relatively rotatable stones, thereby increasing the rate of production of mills not equipped with feed screws for the pressure delivery of the material to be ground into the mill. For example, in the grinding of berries having seeds, the seeds tend to stick and accumulate in the mill and thereby interfere with or inhibit the grinding operation. In the present invention, means are provided for causing the fruit and the seeds to be moved in a positive manner outwardly into the grinding space between the stones. Also, in the grinding of materials, such as exemplified by nuts, the invention provides means having impeller vanes which revolve with the revolving stone of the device and effectively force the materials to be ground outwardly through the milling space between the annular stones.

It is an object of the invention to provide a mill having a lower circular stone and an upper circular stone, the lower stone being connected to the upper end of the rotating shaft so as to be revolved around an approximately vertical axis and the upper stone being held stationary and having an opening approximately in the center thereof, the lower end of this opening being circumferentially expanded so as to define an annular entrance chamber leading to the grinding space between the stones, there being impeller means in this entrance chamber connected to the upper portion of the lower stone so as to be rotated therewith, the impeller means having vanes arranged in a circle so as to define a central receiving chamber and the grinder having means for feeding the product into this central opening. By this simple arrangement a positive feeding action is provided which makes possible grinding with facility many materials which could be formerly ground only with difficulty, if at all.

It is a further object of the invention to provide a device of this character wherein the impeller vanes are of involute form, with such curvature as to produce velocity and force vectors directed so as to attain maximum efficiency and optimum performance characteristics so that not only are the materials fed rapidly through the milling space, but also are ground to a desired state of fineness or consistency.

It is a further object of the invention to provide a grinding mill wherein impellar vanes are arranged in a circle, with the inner ends of these vanes spaced outwardly from the axis of rotation of the mill rotor, to provide a receiving chamber to receive the materials to be ground, the materials then passing radially outwardly from this receiving chamber through the spaces between the vanes to the grinding space of the mill.

It is also an object of the invention to provide means for delivering the materials to be ground directly into the receiving chamber of the rotor.

It is a further object of the invention to provide a grinding mill having annular stones, the working faces of which are slowly worn away, wherein the impeller vanes are so formed with relation to the inner annular portion of the stator stone of the mill that optimum feeding of materials into the grinding space is accomplished and also provision is made for adjustment of the rotor and stator of the grinding mill toward each other without the impeller vanes being brought into grinding engagement with the stator stone.

Further objects and advantages of the invention may be brought out in the following part of the specification wherein some relatively small details have been explained only for the purpose of assuring the completeness of disclosure, without intending, however, to limit the scope of the invention which is defined by the appended claims.

Referring to the accompanying drawings which are for illustrative purposes only:

Fig. 1 is a cross sectional view of a grinding mill embodying the invention wherein the impeller vanes are indicated conventionally;

Fig. 2 is a plan view of the impeller shown in Fig. 1; and

Fig. 3 is a schematic diagram showing the relation of the impeller vanes and the working faces of the rotor and stator stones of the grinding mill.

The grinding mill is ordinarily employed in upright position, and therefore, will be described with its driving shaft in vertical position. The mill has a support 10 including a tubular wall 11 carrying vertically adjustable parts 12 supporting upper and lower bearings 13 and 14 which in turn support a driving shaft 15. A head or rotor 16 is fixed on the upper end of the shaft 15 so as to rotate therewith, this head 16 having a flat upper face 17 circumscribed by an upwardly projecting lip 18 defining, in conjunction with the upper face 17 a flat shallow seat to receive the lower rotor grinding stone 19 which is circular and has a central opening 20. At the upper end of the opening 20 there is an annular recess 21 to receive the radial flange portion 22 of a rotor clamping plate 23 which is secured on the upper threaded end of the shaft 15 by a nut 24 and has the purpose of firmly securing the grinding stone 19 in place on the head 16.

An upper stationary or stator grinding stone 25 is secured in cooperative relation to the stone 19 by an attachment 26 which is removably secured to the upper end of the support 10. This attachment includes an annular plate 27 having an annular recess 28 to receive the upper portion of the stone 25. A clamping ring 29, secured adjacent the lower face of the plate 27 by screws 30, has a lip 31 which engages a peripheral shoulder on

the upper stone 25. The stone 25 has therein an opening 32, the upper end of which is smaller than the diameter of the recess 21. The opening 32 expands downwardly so that its lower end has a diameter approximately the same as the diameter of the recess 21.

The opening 32 of the stator grinding stone 25 is defined by an upper wall portion 32*a* which is approximately cylindrical and a lower wall 33 which flares outwardly as it progresses downwardly. As shown in Fig. 3, the wall 33 is a surface generated by rotation of a concavely curved line 33*a* around the axis of the shaft 15. The curved line 33*a* is approximately an arc having a radius R. The manner in which attrition of the stone 25 occurs may dictate that the curvature of the line 33*a* depart from a true circular arc. From the lower end of the line 33*a* a tangential line 33*b* extends so that as this tangential extension of the line 33*a* is revolved around the axis of the shaft 15, it forms a shallow conical surface 34 which slopes downwardly and outwardly to the annular grinding face 35 of the stone 25 which confronts the annular grinding face 36 of the rotor stone 19. Between the annular grinding faces 35 and 36 there is an annular grinding space 36*a* which may have a vertical height of only a few thousandths of an inch. Radially inwardly of its grinding face 36, the stone 19 has an upwardly sloping conical face 36*b* forming a ramp leading outwardly and upwardly to the grinding space 36*a*. The downwardly and outwardly flaring wall 33 of the stator stone 25 cooperates with the portion of the stator therebelow to define an entrance mouth E leading to the grinding space 36*a*. This entrance mouth E is annular and gradually narrows or diminishes in height as the inner end of the grinding space 36*a* is approached.

The clamping plate 23 also serves as a support for impeller vanes 37 which project upwardly from the peripheral portion thereof into the opening 32 of the stator stone 25. These vanes 37 are curved spirally, as shown in Fig. 2, their curvature being approximately involute. The inner ends 38 of the vanes are nearly vertical, but converge upwardly, as shown in Fig. 1, and the outer ends 39 of the vanes lie approximately in an imaginary surface corresponding to the surface of the wall 33, but being of vertically offset downwardly from the wall 33. The imaginary surface in which the ends 39 of the vanes 37 lie is the surface of generation of an arcuate line 39*a*, having a radius R2 and revolving around the axis of the shaft 15.

The inner ends 38 of the vanes 37 define a circular receiving chamber 40 which communicates with the inner ends of the passages 41 between adjacent vanes 37. Means are provided for delivering the materials to be ground into the receiving space. This delivery means comprises a hopper or funnel fitting 42, the lower end of which comprises a throat member 43 having a downwardly converging conical opening 44, the lower end of which is of diameter not greater than the diameter of the receiving chamber 40 defined by the inner ends 38 of the vanes 37. The materials to be ground are delivered into the space 40 through the opening 44 and by application of centrifugal force therein move outwardly into the passages 41 between the vanes 37, the vanes then acting on the materials to force them outwardly in the annual entrance E leading to the grinding space 36*a* between the stones.

As shown in Figs. 1 and 3, the vanes 37 have portions which extend into the entrance mouth E. The outer ends 39 of the vanes 37, shaped as hereinbefore described, are positioned with relation to the flaring wall 33 of the upper stone 25 so that all points in the outer ends of the vanes 37 are at approximately the same distance from points in the surface of the wall 33 positioned vertically thereabove. For example, as shown in Fig. 3, a point 46 in the end 39 of the impeller vane 37, is disposed at a distance *d* from the point 47 in the surface of the wall 33 disposed vertically above the point 46. Vertically aligned points 48 and 49 respectively, in the end 39 of the vane 37 and in the flaring wall 33 of the stone 25, are spaced vertically at a distance *d*2, thereby providing for gradual upward adjustment of the rotor as the stones 19 and 25 are worn away without the impeller vanes 37 coming into engagement with the stone 25 throughout the useful life of the stones.

Referring again to Fig. 3, during continued use of the stones 19 and 25, the upper portion 50 of the stone 19 above the broken line 51, and the lower portion 52 of the stone 25 below the broken line 53, will be worn away. The vertical offsetting of the contoured ends 39 of the vanes 37 with relation to the flaring wall 33 of the stone 25 permits the rotor, which includes the head 16 and the stone 19 to be adjusted upwardly until the stones have been worn back approximately to the lines 51 and 53, which is the maximum permissible attrition of the grinding stones which are then to be replaced by new stones.

I claim:

1. In a high production positive feed grinding mill having a rotor with an upwardly presented annular grinding face, a stator with a downwardly presented annular grinding face confronting said grinding face of said rotor so as to define therebetween an annular grinding space, said stator having therein a central opening defined by a wall which flares downwardly and outwardly so as to define in conjunction with the adjacent portion of said rotor, an annular outwardly narrowing entrance mouth for said grinding space, the surface of said flaring wall being the surface of generation resulting from the revolution of a concavely curved line around the axis of rotation of said rotor: involute propeller vanes projecting from said rotor into said opening of said stator, said impeller vanes having portions extending in said entrance mouth, the inner ends of said vanes being spaced outwardly from the axis of rotation of said rotor and defining a receiving chamber, the outer ends of said vanes corresponding in shape to said flaring wall of said stator so that each point in the ends of said vanes is approximately the same vertcial distance from the point in said flaring wall vertically above it, so that as said annular grinding faces of said stator and said rotor wear away the ends of said vanes may move toward said flaring wall without engagement therewith until maximum attrition of said annular grinding faces has occurred; and means for directing the product to be milled into said receiving chamber, having an opening confronting said receiving chamber, the diameter of said opening being not greater than the diameter of said receiving chamber.

2. In a high production positive feed grinding mill having a rotor with an upwardly presented annular grinding face, a stator with a downwardly presented annular grinding face confronting said grinding face of said rotor so as to define therebetween an annular grinding space, said stator having therein a central opening defined by a wall which flares downwardly and outwardly so as to define in conjunction with the adjacent portion of said rotor, an annular outwardly narrowing entrance mouth for said grinding space, the surface of said flaring wall being the surface of generation resulting from the revolution of a concavely curved line around the axis of rotation of said rotor: impeller vanes projecting from said rotor into said opening of said stator, said impeller vanes having portions extending in said entrance mouth, the inner ends of said vanes being spaced outwardly from the axis of rotation of said rotor and defining a receiving chamber, the outer ends of said vanes corresponding in shape to said flaring wall of said stator so that each point in the ends of said vanes is approximately the same vertical distance from the point in said flaring wall vertically above it, so that as said annular grinding faces of said stator and said rotor wear away the ends of said vanes may move toward said flaring wall without engagement therewith until maximum attrition of said annular grinding faces has occurred; and means for directing the

product to be milled into said receiving chamber, having an opening confronting said receiving chamber, the diameter of said opening being not greater than the diameter of said receiving chamber.

3. In a high production positive feed grinding mill having a rotor with an upwardly presented annular grinding face, a stator with a downwardly presented annular grinding face confronting said grinding face of said rotor so as to define therebetween an annular grinding space, said stator having therein a central opening defined by a wall which flares downwardly and outwardly so as to define in conjunction with the adjacent portion of said rotor, an annular outwardly narrowing entrance mouth for said grinding space, the surface of said flaring wall being the surface of generation resulting from the revolution of a concavely curved line around the axis of rotation of said rotor: involute impeller vanes projecting from said rotor into said opening of said stator, said impeller vanes having portions extending in said entrance mouth, the inner ends of said vanes being spaced outwardly from the axis of rotation of said rotor and defining a receiving chamber, the outer ends of said vanes corresponding in shape to said flaring wall of said stator so that each point in the ends of said vanes is approximately the same vertical distance from the point in said flaring wall vertically above it, so that as said annular grinding faces of said stator and said rotor wear away the ends of said vanes may move toward said flaring wall without engagement therewith until maximum attrition of said annular grinding faces has occurred; and means for directing the product to be milled into said receiving chamber.

4. In a high production positive feed grinding mill having a rotor with an upwardly presented annular grinding face, a stator with a downwardly presented annular grinding face confronting said grinding face of said rotor so as to define therebetween an annular grinding space, said stator having therein a central opening defined by a wall which flares downwardly and outwardly so as to define in conjunction with the adjacent portion of said rotor, an annular outwardly narrowing entrance mouth for said grinding space, the surface of said flaring wall being the surface of generation resulting from the revolution of a concavely curved line around the axis of rotation of said rotor: impeller vanes projecting from said rotor into said opening of said stator, said impeller vanes having portions extending in said entrance mouth, the inner ends of said vanes being spaced outwardly from the axis of rotation of said rotor and defining a receiving chamber, the outer ends of said vanes corresponding in shape to said flaring wall of said stator so that each point in the ends of said vanes is approximately the same vertical distance from the point in said flaring wall vertically above it, so that as said annular grinding faces of said stator and said rotor wear away the ends of said vanes may move toward said flaring wall without engagement therewith until maximum attrition of said annular grinding faces has occurred; and means for directing the product to be milled into said receiving chamber.

5. In a high production positive feed grinding mill having a rotor with an upwardly presented annular grinding face, a stator with a downwardly presented annular grinding face confronting and in parallel relation to said grinding face of said rotor so as to define therebetween an annular grinding space of uniform thickness, said stator having therein a central opening defined by a wall which flares downwardly and outwardly so as to define in conjunction with the adjacent portion of said rotor, an annular outwardly narrowing entrance mouth for said grinding space, the surface of said flaring wall being the surface of generation resulting from the revolution of a concavely curved line around the axis of rotation of said rotor: involute impeller vanes projecting from said rotor, said vanes being of decreasing height from their inner ends to their outer ends, and said outer ends extending in said entrance mouth, the inner ends of said vanes extending into said opening of said stator, and being spaced outwardly from the axis of rotation of said rotor in close underlying proximity to said flared wall so as to define a receiving chamber from which material therein will be forced via said mouth into the grinding space by said vanes; and means for directing the product to be milled into said receiving chamber.

6. In a high production positive feed grinding mill having a rotatable head, means for rotating said head around its axis, a rotary annular grinding member secured to said head so as to be rotated thereby, said grinding member having a central cavity, a stationary grinding member disposed in confronting relation to the grinding face of said rotary grinding member, said stationary grinding member having a central opening therein which flares outwardly and downwardly so as to form one circumferentially continuous wall of an annular gradually decreasing entrance mouth leading to the grinding space between said grinding members: a body in said cavity; means for securing said body to said head; and vanes projecting into said opening of said stationary grinding member forming an impeller connected to said head for receiving materials to be ground through said opening of said stationary grinding member and forcing the same radially outwardly through said entrance mouth into the grinding space between said grinding members, said vanes having outer edges spaced from but generally following the surface of said one wall.

7. In a high production positive feed grinding mill having a rotatable head, means for rotating said head around its axis, a rotary annular grinding member secured to said head so as to be rotated thereby, a stationary grinding member disposed in confronting relation to said rotary grinding member and coacting therewith to form a grinding space, said stationary grinding member having a central opening therein which flares outwardly and downwardly so as to form one wall of an annular gradually decreasing entrance mouth leading to the grinding space between said grinding members: an impeller connected to said head for receiving materials to be ground through said opening of said stationary grinding member and forcing the same outwardly through said entrance mouth into the grinding space between said grinding members, said impeller comprising an annular plate proximate to the face of said rotary grinding member, and impeller vanes projecting from siad plate having inner end portions extending into said opening of said statonary grinding member and outer end portions extending into said entrance mouth, said vanes having their end portions connected by edges which slope away from said plate and toward the axis of rotation of the impeller across and proximate to the downwardly and outwardly flaring wall of said opening, and the inner ends of said vanes being spaced from the axis of rotation of said rotary grinding member defining a receiving space centrally of said impeller, and means for delivering materials to be ground to said receiving space of said impeller.

8. In a high production positive feed grinding mill having a rotatable head, means for rotating said head around its axis, a rotary annular grinding member secured to said head so as to be rotated thereby, a stationary grinding member disposed in confronting relation to said rotary gringing member and coacting therewith to form a grinding space, said stationary grinding member having a central opening therein which flares outwardly and downwardly so as to form one wall of an annular gradually decreasing entrance mouth leading to the grinding space between said grinding members: an impeller connected to said head for receiving materials to be ground through sad opening of said stationary grinding member and forcing the same outwardly through said entrance mouth into the grinding space between said grinding members, said impeller comprising an annular

plate extending transversely of the opening of said stationary grinding member proximate to the face of said rotary grinding member, and impeller vanes projecting from said plate into said opening of said stationary grinding member, said vanes in each case having a projecting edge extending between its outer end in said entrance mouth and its inner end in said opening of said stationary grinding member, which edge substantially conforms to said one wall of the entrance mouth and slopes away from said plate and toward the axis of rotation of the impeller, and the inner ends of said vanes being spaced from the axis of rotation of said rotary grinding member defining a receiving space centrally of said impeller; and means for delivering materials to be ground to said receiving space of said impeller, comprising an annular wall forming a mouth communicating with said receiving space, said mouth having a diameter smaller than the diameter of said receiving space.

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CERTIFICATE OF CORRECTION

Patent No. 2,980,353 April 18, 1961

Donald J. Brown

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 63, for "annual" read -- annular --; column 6, line 48, for "siad" read -- said --; line 49, for "statonary" read -- stationary --; line 65, for "gringing" read -- grinding --; line 72, for "sad" read -- said --.

Signed and sealed this 17th day of October 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC